USDA-ARS/
U.S. Wheat and Barley Scab Initiative
FY10 Final Performance Report
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Cover Page

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Fiscal Year:	FY10
USDA-ARS Agreement ID:	59-0790-8-071
USDA-ARS Agreement Title:	Management and Resistance Sources for Control of FHB in Barley.
FY10 USDA-ARS Award Amount:	$ 23,970

USWBSI Individual Project(s)

USWBSI Research Category*	Project Title	ARS Award Amount
BAR-CP	Validation and Refinement of DON Models in Barley for the Northern Great Plains.	$ 5,854
BAR-CP	Field Tests of Transgenic Barley Lines.	$ 3,596
BAR-CP	Screening Barley for FHB Resistance in ND and Coordination of the NABSEN.	$ 14,520
	Total ARS Award Amount	**$ 23,970**

Principal Investigator Date

* MGMT – FHB Management
FSTU – Food Safety, Toxicology, & Utilization of Mycotoxin-contaminated Grain
GDER – Gene Discovery & Engineering Resistance
PBG – Pathogen Biology & Genetics
BAR-CP – Barley Coordinated Project
DUR-CP – Durum Coordinated Project
HWW-CP – Hard Winter Wheat Coordinated Project
VDHR – Variety Development & Uniform Nurseries – Sub categories are below:
SPR – Spring Wheat Region
NWW – Northern Soft Winter Wheat Region
SWW – Southern Soft Red Winter Wheat Region

Project 1: *Validation and Refinement of DON Models in Barley for the Northern Great Plains.*

1. **What major problem or issue is being resolved relevant to Fusarium head blight (scab) and how are you resolving it?**

   Malt and Feed barley producers in the upper Midwest need a prediction model for forecasting the risk of FHB and DON accumulation. An effective FHB risk advisory system is available but the model used to develop the system was based on environmental factors associated with disease occurrence levels in wheat thus the system may not be effective at predicting disease severity for barley because the risk factors and duration of risk to barley appear to differ from those of wheat. Additionally, a model for DON accumulation is not available and this is the most important criteria used by the malting industry when deciding to purchase barley for malt production. Jeff Stein at South Dakota State University is coordinating a multistate effort to investigate the effect of environmental conditions on FHB severity and the accumulation of DON in barley. NDSU recorded disease and environmental parameters for 3 six-rowed barley lines (Tradition, Robust, and Quest) and one two rowed variety (Conlon) across 4 locations in North Dakota (Carrington, Dazey, Prosper and Fargo, ND). Disease, heading date and environmental data was collected for these lines across all sites; environmental conditions were natural – no mist irrigation or artificial inoculation. Weather data was collected from nearby NDAWN weather stations.

2. **List the most important accomplishment and its impact (i.e. how is it being used) to minimize the threat of Fusarium head blight or to reduce mycotoxins. Complete both sections (repeat sections for each major accomplishment):**

   Accomplishment: Disease and weather data were collected from four North Dakota locations representing different environments, soil types and cropping systems (Carrington, Dazey, Prosper and Fargo, ND). The data collected from each location was: heading date, FHB incidence and severity, and DON accumulation in harvested samples. Weather conditions were generally normal for temperatures and slightly below normal for rainfall at Carrington and Dazey and normal for Fargo and Prosper in 2010, and disease severity averaged less than 15% and DON levels ranged from 0.05 to 0.73 ppm. Prosper was the only location that was above the 0.5 ppm threshold. Data on disease severities, DON, and environment were sent to South Dakota State to be included in Dr. Stein's data set.

   Impact: The data collected in North Dakota has helped to develop a prediction model for FHB severity and DON accumulation in barley. The forecasting system has been developed based on the barley model and future data will help to validate its effectiveness. The information will be accessible to producers and crop advisors allowing more informed decisions on fungicide use.

Project 2: *Field Tests of Transgenic Barley Lines.*

1. **What major problem or issue is being resolved relevant to Fusarium head blight (scab) and how are you resolving it?**
   Commercially accepted barley lines grown in the upper Midwest are susceptible to FHB and have DON accumulation levels exceeding those acceptable by the malting industry. Breeding programs have made consistent progress to bring DON levels down and some of these lines have been approved for malting quality. However, DON accumulation may still be above acceptable industry standards in these new lines when environmental conditions are conducive for a major FHB epidemic. Transgenic barley lines with novel or synthetic sources of resistance will allow for a boost in resistance and lower DON accumulation that is not available through endogenous genes currently available from the primary barley germplasm pool.

2. **List the most important accomplishment and its impact (i.e. how is it being used) to minimize the threat of Fusarium head blight or to reduce mycotoxins. Complete both sections (repeat sections for each major accomplishment):**

   Accomplishment:

   The NDSU barley pathology program is cooperating with Dr. Lynn Dahleen from the USDA-ARS facility in Fargo, to field screen transgenic materials she has developed. The NDSU barley pathology project planted the material, applied corn based inoculum, set up the misting system and maintained the nursery, all in Langdon, ND. Dr. Dahleen evaluated the nursery for disease and harvested the grain for DON evaluation. See Dr. Dahleen's project report for the accomplishments she has achieved with this project.

   Impact:

   See Dr. Dahleen's report on this project.

Project 3: *Screening Barley for FHB Resistance in ND and Coordination of the NABSEN.*

1. **What major problem or issue is being resolved relevant to Fusarium head blight (scab) and how are you resolving it?**

   The objective of this project is to coordinate the disease screening of elite barley germplasm in uniform FHB nurseries in North America. Advanced barley lines with FHB resistance were tested in mist-irrigated sites, as well as under normal rainfall conditions. Mist-irrigated nurseries were also artificially inoculated with Corn innoculum containing *Fusarium graminearum* spores. The FHB nurseries have been continually established and evaluated for this project for more than 10 years and currently is known as the North American Scab Evaluation Nursery (NABSEN). In 2010, we established nurseries at three locations in North Dakota located at Fargo, Langdon, and Casselton. Other locations established by other cooperators included St. Paul and Crookston, MN, Brandon, Manitoba, and Hangzhou,

China. In ND, the Casselton and Osnabrock nurseries weres not irrigated while the Fargo and Langdon sites were under mist irrigation. The nurseries included breeding lines with putative FHB resistance from the NDSU 2-rowed and 6-rowed breeding programs and lines from the Univ. of Minnesota, Busch Ag, and Agriculture and Agri-Food Canada. FHB parameters, DON, and agronomic factors are recorded

2. **List the most important accomplishment and its impact (i.e. how is it being used) to minimize the threat of Fusarium head blight or to reduce mycotoxins. Complete both sections (repeat sections for each major accomplishment):**

Accomplishment: The nursery contained 50 lines, including 6 resistant and susceptible controls. Short rows with three replications were planted at each location. Heading dates were recorded at Fargo, Langdon and Brandon, Manitoba and FHB incidence were recorded at Fargo, Langdon, and Brandon, Manitoba. FHB severity was recorded at Fargo, Langdon, Brandon, Manitoba, St. Paul and Crookston, MN all six of these locations were under mist irrigation. DON levels were recorded from all seven locations in U.S. and Manitoba, Canada. FHB severity was low at the Osnabrock and Casselton, moderate in Fargo ND, St. Paul and Crookston, MN and high in Brandon, Manitoba and Langdon, ND. Plants were harvested and samples analysed for DON in Paul Schwarz's lab at North Dakota State University. DON levels varied much between locations with the dryland locations having the lowest levels with a range from 0.2-1.0 ppm and misted nurseries ranged from 9.4 to 27.9 ppm. One Canadian two- rowed line under mist irrigation had the lowest DON level of 9.4 ppm which was lower than Conlon the two- rowed standard. None of the six- rowed lines under irrigation had lower DON accumulation levels than the new six-rowed standard, ND 20493. Seed was also redistributed and sent to Hangzhou, China for testing.

Impact: Significant progress is being made toward developing FHB resistant barley cultivars. All North American barley breeders have access to the data collected in this project. The breeders are able to use the relative performance data to make decisions about continuing or dropping particular breeding lines. Breeders now have: 1) tests of the resistance stability of their breeding lines across a range of environments and disease pressures; 2) a measure of the resistance in their advanced lines compared to those of the other barley breeders in North America; 3) access to unique germplasm with resistance to FHB and DON accumulation. The 10 years of FHB data and SNP genotyping of many of the NABSEN entries also provides the opportunity to conduct an association mapping project to identify FHB resistance QTL.

Include below a list of all germplasm or cultivars released with full or partial support of the USWBSI. List the release notice or publication. Briefly describe the level of FHB resistance.

None

Include below a list of the publications, presentations, peer-reviewed articles, and non-peer reviewed articles written about your work that resulted from all of the projects included in the grant. Please reference each item using an accepted journal format. If you need more space, continue the list on the next page.

None